MARCH 1992

LSI LOGIC OPERATIONAL SYSTEMS ASSESSMENT

INPUT®

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A

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I. Introduction

The following report presents the results of a study conducted by INPUT for LSI Logic's (LSI) senior management for the purposes of examining its current operational systems environment and the processes associated with both the day-to-day and long-range systems management and planning efforts.

Ed Cannon, Vice President and CIO of Management Information Systems, was INPUT's primary LSI contact throughout the study. Ed's efforts to schedule executive-level interviews and facilitate the execution of the study contributed significantly to the results.

The report is organized as follows:

- *Chapter II - Background and Objectives* presents background information, outlines the study's objectives, and discusses the overall methodology utilized in conducting the analysis.
- *Chapter III - Executive Summary* presents a brief synopsis of the study's results, conclusions and recommendations.
- *Chapter IV - Management Views of the Current Systems Environment* summarizes the results of the on-site interviews conducted with executives and managers on such subjects as the current systems environment, short- and long-term systems needs, existing systems management processes, and user views on the evolution of systems at LSI.
- *Chapter V - Comparing LSI to Other Firms* analyzes LSI's current systems environment in light of other firms in its industry. Comparisons are drawn on a number of topics including cost, user satisfaction and longer range requirements.

- *Chapter VI - Conclusions and Recommendations* presents INPUT's assessment of the systems environment and specific recommendations on next steps and possible strategies for optimizing LSI's use of systems technology in the future.

Two appendices are included in this report.

- *Appendix A* lists all interviewees consulted with during the study. The list contains both LSI executives and managers as well as the list of firms interviewed in order to develop the comparative analysis between LSI and other firms within the industry. *(See Chapter V.)*

- *Appendix B* includes the interview guides utilized with user, MIS, and outside firms.

II. Background and Objectives

This chapter presents the background and objectives as well as the methodology used to conduct the study.

A

Background

LSI's business has grown substantially over the past several years. During that period the company has developed the capability to rapidly prototype and develop specialized chips to meet customer-specific requirements with constantly decreasing development life cycles. The engineering systems to support the design and development of these products have evolved as well. At the same time, the company has grown in both size and scope to the point where its operational systems could provide both an opportunity and a threat to its competitive position.

To insure that these operational systems continue to facilitate the growth of the business, LSI established a corporate MIS function approximately a year ago. Since its establishment, the function has focused on pulling together a business and operational systems environment to meet the following objectives:

- Selection and implementation of an applications suite that would have the capability to support LSI's operational and financial reporting requirements on a worldwide basis.
- Establishment of the necessary standards to insure uniformity of business operations throughout the company.

Prior to the formation of the MIS function, everyone had literally "done their own thing" with regard to systems. While this was an acceptable approach to the systems problem earlier in the company's life cycle, executive management recognized that this strategy would be unlikely to position the company as a global player in its industry in the 1990s.

1. 1991 Systems Activity

Primary focus for the past year has been linking the key business systems. Four major systems introductions have been made since MIS was formed. The new systems tie all the major business processes - operational and accounting - together based on a series of rules that force a much higher level of closure on codes and business processes than the systems they replaced, and have taken the systems environment from a decentralized "batch" orientation to one that is centralized and on-line. The major systems implemented during the year were:

- COLSIS (Corporate LSI System): An integrated sales and administration system. (IBM-based/IMS)
- McCORMACK & DODGE: Upgrade to on-line financial packages. (IBM-based)
- MAESTRO: A system to manage chip design and specification of manufacturing processes. (DEC/VAX-based, Oracle Data Engine)
- PLANNING SYSTEM

In addition to the systems previously mentioned, other key systems that were considered for the purposes of this study are primarily in the manufacturing area. They are:

- MMS (Metals Master Scheduling)
- PROMIS (Manufacturing)
- LLAMDAA (LSI Acquisition of Manufacturing Data Analysis)

Nomad is used for the development of custom reports from the core administrative data. MIS has also released an end-user report generation package, GURU, which operates utilizing the NOMAD environment.

Finally, during 1991 the business data processing center, originally under MIS management, was consolidated with the engineering center and placed under the management of ASIC Engineering.

2. 1992 Plans

Major plans for 1992 call for:

- Implementing a single COLSIS source code for Europe and the U.S.
- Creating a single IMS platform for the U.S.
- Linking the LLAMDAA and PROMIS systems
- Linking the manufacturing systems more tightly with COLSIS
- Looking into EDI

B

Objectives of This Study

The major changes that took place in the systems environment in 1991 have had significant impact on LSI. The shift from a decentralized to a centralized environment, from primarily batch to on-line systems, and the integration of key systems have forced major changes in the way business is conducted and has tested the ability of the organization to absorb change.

Much has been accomplished in the evolution of the systems environment since the formation of MIS. Nevertheless, it is executive management's view that it is time to examine the overall direction of the systems activity to ensure that a long-range plan is put in place that will guarantee that LSI's systems environment will be comparable to that of the rest of the industry and supportive of LSI's business objectives and operating style.

1. Project Objectives

To obtain an objective evaluation of the current state of the systems environment, LSI engaged INPUT to conduct this study. The primary objectives of the study as stated in INPUT's proposal dated October 22, 1991, were to:

- Provide an assessment of the current operational systems environment in terms of users' short-term needs

- Examine the approaches taken by other firms in the industry in dealing with these systems requirements

- Recommend a long-range target environment and process for achieving it

- Examine and recommend outside resources which might be utilized in facilitating the process

2. Project Scope

The scope of the study was limited to the examination of LSI's operations systems: more specifically, those systems that support the sales, manufacturing, logistics and customer service functions. Explicitly excluded from the study were systems that are primarily utilized for product design, research and development and in-plant process control, except to the degree that these systems interface directly with the core operational systems.

The assessment also included an examination of the current systems management processes.

It should be noted that the term "assessment" as used in this study means the examination of the overall attributes of a system or a process. The "assessment" of a system addresses such attributes as its business functionality, operational integrity and user friendliness. Assessment as used here does not address the system's technical internals such as code quality and maintainability, architecture, etc.

C

Study Methodology

Coordination of LSI's Operational Systems Assessment was handled by Ed Cannon, VP/CIO of Information Systems, and his staff. Ed and his organization did an excellent job of providing background and technical information on the systems, setting up internal interviews and providing potential contacts in other firms for gathering data on competitors' systems strategies.

The project was managed on INPUT's side by Denny Wayson, VP of U.S. Operations. Other INPUT staff members key to the success of the project included Doug Tayler, VP of Research and INPUT's senior telephone interviewing staff. The analysis represents a joint interpretation of the interview results by Denny and Doug.

The primary sources of information utilized in completing this study were face-to-face interviews with key LSI operational executives and telephone interviews with other firms in the industry.

1. Overall Methodology

- A kick-off meeting was conducted with LSI executive management to finalize the project objectives, methodology and scope; and to secure top management insight and support in identifying key prospects in LSI's management to participate in the end-user interviews.

- A series of interviews was conducted with Ed Cannon and his staff to obtain the following information:

  - Identification of the key systems to be included in the study

  - An overview of the existing applications architecture for those systems to be included in the study

  - Identification of key interfaces between systems which interact on a regular basis with suppliers, customers and outside financial institutions

  - Information Systems' perspectives on the current issues, long-range systems direction and potential alternatives for upgrading the operational systems environment

- Based on the information gathered at the kick-off meeting and an analysis of the MIS interviews, INPUT prepared an interview guide and set up meetings with key operational executives to obtain the following types of information:

  - Their views on existing systems

  - As assessment of short-term needs for information as well as required improvements in the existing systems

  - Insights into longer term information requirements which, if delivered, might significantly impact their organizational effectiveness

- During the end-user interviewing process INPUT initiated a series of interviews with other firms in the industry to gather information on their systems environments.

- Utilizing the information gathered through all three sets of interviews, the analysis presented in this report was developed.

2. User and Information Systems Interviews

A total of twenty-four individuals participated in either group or individual interview sessions. *Exhibit II-1* summarizes the number of individuals interviewed by business unit. *Appendix A* lists the individuals and their titles by business or organizational unit.

EXHIBIT II-1

Interview Count by Business Unit

Business Unit	Number
Information Systems (MIS)	5
Headland Technology	1
LSI Logic Europe	1
Microprocessor/DPS Products Group	2
Finance	3
Sales	3
Customer Services & Logistics	2
Office of the Chief Executive	2
Worldwide Operations	1
Integrated Silicon Engineering	1
ASIC Products Group3	

3. Competitor Interviews

Interviews were conducted with IS executives from 8 large corporations, primarily computer and semiconductor manufacturers. Participants included the following firms:

- Advanced Micro Devices
- Applied Materials Corporation
- Hewlett-Packard
- Intel Corporation
- National Semiconductor
- Sun Microsystems
- Tandem Computers
- Raytheon

4. Analysis

The analysis and interpretation of both the LSI and competitive interviews was performed by Denny Wayson and Doug Tayler as a joint effort. Results of the analysis are presented in the remaining chapters of this report.

III. Executive Summary

This chapter presents the highlights of INPUT's study of LSI's operational systems environment. More detailed information on the analysis performed and specific conclusions and recommendations can be found in the remaining chapters.

A

Background, Objectives and Methodology

1. Background

LSI has experienced significant business growth over the past several years. As LSI's business has grown in volume and complexity, the supporting operational and business information systems have attempted to keep up with constantly growing and changing requirements.

To insure that the company's information systems will meet the business requirements, LSI's executive management established a centralized information systems function a little over a year ago. Since its establishment, MIS has taken on a number of significant implementations of operational systems under a charter of integrating LSI's operational systems environment.

These implementations have not been accomplished without some pain. In particular, COLSIS, the company's integrated sales and administrative system, had a difficult start-up.

With a year of systems activity under the new management structure behind it, LSI's executive management team retained INPUT to assess the current situation with regard to LSI's operational systems and the current systems management process.

2. Objectives

The key objectives of the study conducted by INPUT were to:

- Provide an assessment of the current operational systems environment
- Examine the approaches taken by other firms in the industry in dealing with these systems requirements
- Recommend a long-range target environment and process for achieving it
- Examine and recommend outside resources which might be utilized in facilitating the process

3. Methodology

After a kick-off meeting with LSI management to finalize study requirements, INPUT conducted three sets of interviews to gather the information necessary to perform the analysis.

- Interviews were conducted with the VP of MIS and his staff to obtain background information on the operational systems and the management processes used by MIS.
- Twenty-four interviews were conducted with LSI executives and their direct reports to obtain their views on existing systems, their short-term needs and longer range systems objectives. (*Appendix A* contains a roster of the users interviewed as part of the study.)
- Eight interviews were conducted with firms in LSI's industry group to obtain information on their approaches to operational systems and assessments of their degree of satisfaction with them. (*Chapter II, Section C-3* lists the firms interviewed.)

Based on the information gathered through these three interview sets, an analysis was performed by INPUT's project management team. The full presentation of the results is contained in the remaining three chapters of the report.

B

LSI's Current Systems Environment

LSI's current systems environment is dominated by COLSIS. It is the key integrating system in the suite of applications that tie the manufacturing shop floor to sales and accounting. The criticality of COLSIS was strongly reinforced by the interviews. Virtually every business unit considered it critical.

Analysis of the interview data leads to some observations about COLSIS.

- Putting aside some of the difficult implementation issues, it is INPUT's conclusion that the decision to proceed with COLSIS in the U.S. was probably a reasonable first step in moving toward an integrated set of operational applications.
- Several implementation issues, including training, system cut-over, system performance, etc., have left users dissatisfied with COLSIS. In many instances, that dissatisfaction is declining as time passes and users become more familiar with the system.

  INPUT believes that the biggest factor generating negative user reactions to COLSIS is the fact that it forces a level of discipline on systems users that is counter to LSI's culture and was clearly not anticipated. This type of discipline is required to ensure the data integrity of virtually all on-line transaction processing systems. However, in the case of COLSIS, the lack of friendliness of the user interface aggravates the situation. This is particularly true for casual end-users, or executives attempting to use the system for the manipulation of management information.

Putting COLSIS aside for the moment, most users had significantly fewer complaints about the other systems impacting their operations. In general, the current operational systems environment works. It has problems, and as will be pointed out later, some consideration needs to be given to whether it is the right environment for LSI in the long term.

C

The Quality of LSI's Systems Management Processes

Based on the interview data, LSI's executive management gives MIS an above-average rating for managing the processes associated with maintaining and enhancing the installed applications base.

MIS scored an acceptable rating for the following systems management processes:

- Short-Range Systems Planning
- Systems Development
- Systems Installation and Test (Post COLSIS)
- General Communications (On operational matters)
- Quality Assurance

Key processes where MIS fell short in the eyes of user management were:

- Long-Range Systems Planning
- User Training
- Post-Installation Assessment and Support

Long-range systems planning and ongoing customer support are the key processes requiring improvement. INPUT believes that significant improvements made in these two areas will stimulate a higher degree of user satisfaction and improvement in the quality of other processes covered in the survey. To achieve that objective, a new level of, and more frequent communications between, the end-user community and MIS must occur. The communications will need to be focused on planning and mutual goal setting--not problem solving, the primary subject today.

D

Systems Priorities

Based on survey results, LSI's end-users' systems priorities reflect a mixture of long-range requirements and short-range frustrations. *Exhibit III-1* shows how frequently specific systems priorities were cited as critical by each of the eleven business units participating in the study.

EXHIBIT III-1

User Priorities for Information Systems

Systems Need	Number Mentions
Worldwide Integration of Operational Systems	6
End-User Information Management Tools	6
Graphical User Interfaces/Integrated Help	6
Improved Long-Range Planning Processes	5
Code and Process Standardization	4
Tighter Integration of Factory Systems	3
Product/Service Margin Reporting	3
Improved Documentation and Training	3
Electronic Data Interchange	2

The frustration points are primarily focused on planning processes and end-user systems interfaces. The business priorities seem to be focused on obtaining a universal (global) systems capability and tighter integration of operational systems. In INPUT's view these are all appropriate and critical priorities for LSI that need to be addressed by LSI management.

E

Comparing LSI to Other Firms in Its Industry Group

The survey of other firms in LSI's industry group yielded considerable information on how LSI compares in terms of its business systems environment. A detailed comparison is contained in *Chapter V*; a quick synopsis follows.

- *Computing Environment/Operational Systems* - Virtually all eight of the firms interviewed run their business and operational systems in a heterogeneous network environment. IBM and DEC are predominant architectures. However, there is considerably heavier use of LAN-based technology to provide end-user support than currently deployed at LSI.

- *Computing Environment/R&D and Engineering Systems* - For the competitive firms surveyed, the environment is essentially the same as LSI's (heavy use of workstations with a dominance of Sun).

- *New Technology Deployment (Business and Operational Systems)* - This is an area where LSI appears to be behind its competitors. It appears from the survey that the majority of the firms in LSI's industry group are making significant headway in deploying the following classes of technology to facilitate and upgrade their business systems environments.

  - Relational and distributed relational data base management systems

  - Local-area network (LAN)-based information and departmental systems

  - Client/server architectures and the use of CASE tools to facilitate the rapid and cost-effective development of new data processing systems

- *Use of Outside Services* - The survey indicates that firms in LSI's line of business make relatively heavy use of outside services and software. Six of the firms in the sample have examined major

outsourcing strategies, but none have gone that route to date. LSI utilizes a reasonable amount of outside software, but does not spend nearly as much as the sample group does (18% of budget) on services.

- *Systems Priorities - Exhibit III-2* shows how the firms participating in the survey ranked their systems priorities.

EXHIBIT III-2

Top Systems Priorities - LSI's Competitors

Systems Priorities	Number Mentions
Downsizing or Distributing Applications	11
Improving User Access to Information	6
Re-Engineering Application/Network Architecture	5
Making Greater Utilization of Outside Resources	4
Moving in the Direction of CASE Technology	3

- In some areas, such as improving user access to information, outside firms tend to coincide with LSI's priorities . However, the top item on the list--downsizing or distributing applications--which could be a cost-effective solution to some of LSI's systems problems, is not being considered by MIS at this point in time.

- *Quality and Cost* - Although it's difficult to get an "apples to apples" comparison for these two areas, INPUT believes that the survey results point to the following conclusions:

  - The majority of the firms surveyed have a higher opinion of their business and operational systems and systems management processes than does LSI's executive management.

  - LSI is probably spending less in the area of business systems than the average firm.

This is not surprising, considering that LSI appears to be late, compared to other firms, in formalizing and focusing on its systems environment.

F

Conclusions and Recommendations

A complete set of conclusions and recommendations is contained in *Chapter VI*. This section is taken directly from *Chapter VI, Section I - Summary - Conclusions and Recommendations*.

LSI is at a crossroads in the evolution of its information systems. The work that has been done in the last year has been significant, and lays a foundation for moving forward. Nevertheless, some key decisions need to be made now that will impact the effectiveness of the systems environment significantly over the next five years.

To some extent, making the correct decisions from here on out is as heavily impacted by LSI's long-range business objectives and style as by the growing array of technological alternatives.

Based on the overall analysis of both the internal and external survey results, INPUT believes the following items should get priority attention:

- Taking short-term action to address executive information requirements
- Developing a total MIS long-range plan that is more than a short-term application development strategy. The plan, in supporting the overall business direction, should:
  - Address the long-term direction for transaction processing and the COLSIS system.
  - Consider further integration of manufacturing systems.
  - Provide for the necessary architecture and professional services to support Executive Information Systems.
  - Define LSI's requirements with respect to outsourcing.
- Reorganizing customer support so that there is a single spot where customers begin their search for help, and implementing processes to get results from the organization(s) ultimately responsible
- Establishing agreement with corporate management to recognize and accept their mutual responsibility to see that LSI's systems are designed and operated to achieve the corporation's objectives

Finally, INPUT believes that LSI should adopt a model for managing systems that has the following characteristics:

- Relies on strong centralized planning processes and coordination of standards
- Centralizes management of operations and data administration even though the ultimate form of LSI's operational network and data base environment might well be quite distributed
- Decentralizes (over time) applications development activities that are unique to individual operating divisions
- Establishes operating executive (user) involvement in major systems-related projects such as setting manufacturing standards
- Facilitates approach to end-user customer support and executive information systems

INPUT believes this type of approach will encourage user ownership and participation in the systems management process in a manner consistent with LSI's corporate culture. The result will be systems that efficiently sustain day-to-day operations and also support the growth and evolution of LSI's business.

IV. Management Views of the Current Systems Environment

The analysis contained in this chapter is based on two primary sources of information:

- Information gathered through the face-to-face interviews of LSI's operational and MIS management utilizing the interview guide contained in *Appendix B*
- Data collected on Systems Profiles distributed during the on-site interviews. A sample of a systems profile is also included in *Appendix B*.

Upon the completion of each interview, the interviewee's comments were compiled in an interview guide. The interview guides are part of the study documentation and will be kept on file by INPUT. At the close of each interview the LSI executive was asked to have an appropriate person in their organization fill out a System Profile for each major system utilized by the organization and return them to INPUT for use in the analysis.

The remainder of this chapter utilizes the information described above to present INPUT's analysis of:

- Systems Criticality
- COLSIS
- LSI's Systems Management Processes
- Systems Priorities
- User Attitudes

A

Systems Criticality

As part of the interviewing process, end-users were asked to list key systems, i.e., systems that they felt had critical impact on their business operations. A simple tabulation of the responses *(Exhibit IV-1)* gives

testimony to the criticality of COLSIS as the core repository of business information for the firm. Of the total of 11 business units interviewed, all 11 cited COLSIS as the critical system.

EXHIBIT IV-1

Number of Mentions of Key Systems

System	# Mentions
COLSIS	11
Financial Packages 7	
MAESTRO	5
PROMIS	4
LLAMDAA	3
LPROJ/CPROJ/GURU	2

Systems unique to certain business units were also mentioned, including ASK manufacturing systems (mentioned by John Dickson/HEADLAND Technology), MMS (Master Metals Scheduling) and QUOTA, a home-grown system for dealing with quota management in the ASIC Products Group.

Nevertheless, COLSIS emerges not only as the most critical system in the suite of operational systems, but also as the primary integrator of the other systems in the suite. Virtually the entire set of systems listed in *Exhibit IV-1* supplies data to, relies on data from, or utilizes the information repository managed and maintained by COLSIS.

To this degree, COLSIS dictates the current and (most likely) the future architecture of LSI's operational systems, and warrants further discussion.

B

COLSIS

Virtually every user interview began with a discussion of COLSIS. To some degree this emphasis on COLSIS was a disadvantage with regard to gaining insights into LSI's overall systems environment. On the other hand, COLSIS is so critical and core to the company's operations that it provided a pivot point for discussing general systems processes and support. The user interview notes regarding COLSIS constitute a full fifty pages. In order to condense this material for the purposes of this study the information has been organized into the following subject areas:

- Selection of the COLSIS Strategy
- Implementation
- Issues Related to COLSIS

1. Selection of the COLSIS Strategy

It is quite clear from the interview data that the decision to migrate the COLSIS systems, developed in Europe, to the U.S. environment was made under a great deal of pressure. There was a need to do something quickly, and the newly formed MIS function was charted to straighten out a pressing problem with the U.S. systems.

Of the 11 executives interviewed, two felt that MIS should have taken another course of action. Everyone else felt the die was cast by the time the newly formed MIS function appeared on the scene. In any event the strategy to go forward with COLSIS was initiated. To make it work, hundreds--perhaps thousands--of adjustments had to be made to the European code. Nevertheless, it is INPUT's conclusion that COLSIS selection was the right decision at the time (despite some of the implementation difficulties) for the following reasons:

- Off-the-shelf systems to provide the functionality required by LSI's business are virtually nonexistent.

- Development and implementation of a totally new system would have probably been a three-year effort at significantly higher cost.

- No real processes were in place to ensure that specifications could have been developed that would have resulted in a significantly richer set of functional capabilities in terms of transaction processing.

2. Implementation

From a user's perspective, the implementation was extremely difficult and, in many instances, disruptive. Users blame poor project management, inadequate training and documentation, insufficient testing and a lack of on-site implementation support for their difficulties. It is INPUT's view that to some degree all of these were contributing factors. However, there were a number of fundamental underlying situations that made this implementation difficult.

- The system forced significant change in both the behavior and attitude of users. Its implementation imposed an unprecedented discipline on all levels of users within LSI's U.S. operations.

  - It required complete specification of product attributes as part of the order entry function.
  - It imposed additional discipline to navigate the data base.
  - From the viewpoint of some users, it increased the workload to execute their jobs. (That is, some people's work appeared to increase in complexity.)

- The system did not come on-line easily. There were problems with response time and data conversion. This resulted in some severe disruptions in business operations.

These are not unusual start-up situations for major systems of this type, which require a major a "drop dead" cutover scenario. Probably, both MIS and the user community underestimated the full impact and potential problems that might occur.

3. Issues Related to COLSIS

Irrespective of the technical issues related to COLSIS implementation, there are a number of other factors that impact user satisfaction with the system. The two listed below are probably the most significant.

- An underlying cultural issue remains. LSI is an entrepreneurially oriented company. Having outgrown the ability to manage business operations on a less formal basis, an approach that required more discipline was, and remains, an absolute necessity. Nevertheless, COLSIS seems overly restrictive, particularly in terms of ease of access to the wealth of data it contains.

- Users claim that for certain work activities, COLSIS has increased the amount of time required to perform particular functions. (This remains the case, even though proficiency in the use of COLSIS has developed over time.)

C

LSI's Systems Management Processes

One of the key objectives of the study was to gain an understanding of how well the current systems management processes support the ongoing evolution of LSI's systems. To gather information to support that objective, each end user was asked to rate a total of ten processes on a scale of 1 to 5 with a 1 indicating "very poorly" and a 5 indicating "very well." In addition to providing a rating, respondents were asked to comment on each process.

Exhibit IV-2 shows the results of the tabulation of these ratings grouped into three categories. A discussion of critical processes follows, incorporating respondents' key comments where appropriate.

EXHIBIT IV-2

Quality Evaluation of LSI's Systems Management Processes

Quality Level	Process
High	Systems Maintenance (Applications)
Medium	Systems Planning - Short Range Systems Development Systems Installation and Testing General Communications Quality Assurance
Low	Systems Planning - Long Range User Training Post Installation Assessment User Involvement

Before drawing any conclusions regarding the results, some qualifying statements should be made.

- It has been just over a year since the MIS function came into existence. Although INPUT did not spend a significant amount of time probing the history of systems at LSI, it became clear throughout the interviewing process that formal processes being evaluated here were virtually nonexistent prior to the creation of the MIS function. To have all of these processes up and running satisfactorily after one year of operation would be a Herculean accomplishment by anyone's standards. This is particularly true in light of the major implementation work that the MIS organization has undertaken since its creation.

- Several of the senior managers interviewed have had little experience with systems management processes. In some cases these managers requested that direct reports or others in their organization respond. While this approach supplied good information on those processes associated with the tactical side of systems management, the insights provided on longer range issues were limited.

- The COLSIS halo effect applies; i.e., significantly distasteful recollections of the COLSIS implementation probably are coloring the results even though implementations of other systems may have gone smoothly.

INPUT believes that these qualifying statements bias the results toward the negative side. As a result they should not be interpreted as a "scorecard" on the performance of MIS management. Almost every respondent felt that progress had been made throughout the year in most areas. Nevertheless, there are some areas where significant improvements need to be made in LSI's systems management processes.

1. Systems Planning - Short and Long Term

- In general, short-term planning for the implementation of modifications to existing systems seems to be working. Improvements need to be made in the prioritization process and user communications, but in general the process works.
- Long-range planning is another issue. From a user executive perspective, there is no long-range systems plan. MIS has produced a planning document, but from the user executive's perspective, it's MIS's plan. INPUT's view is that a long-range systems planning process will require significant effort, and should be launched as soon as possible. Linking business objectives with systems strategies is to some degree an art that will require higher quality and more frequent communications between MIS and executive management than exist today. Specific suggestions are made in *Chapter VI.*

2. Systems Development/Project Management

- In general users felt that development and maintenance processes seemed to work; i.e., once it was established what will be done, the actual generation of the code to meet specifications is executed professionally.
- On the other hand, most users felt that implementation processes suffered severely from a lack of strong project management. Users complained on the one hand that there were too many people involved in making decisions about systems during implementation (even on the user side), but are clearly reluctant to turn over the tactical decision making to MIS. Yet user executives seemed reluctant to take charge of the user side of the implementation process.

Improvements in the communications processes between executive management and MIS, along with refinements in the planning processes, would provide a solution.

3. Communications

The current style and frequency of communications between users and MIS is a key factor in some users' dissatisfaction with LSI's systems management processes. Two examples based on comments drawn from the user interviews point out some of the ways in which the current style of communication inhibits the effectiveness of LSI's systems management processes.

- *Communications Between the Office of the CEO and Executive Management* - Constant reinforcement is required to make a systems strategy stick, particularly when the CIO is new to the organization. Several executives pointed out that they were able to get approval to proceed on systems-related efforts of their own without coordinating the activity through MIS. This would be all right in an environment where longer term systems objectives and standards were well established, and local systems initiatives were approved in context. However, until that context gets established, approving local efforts outside of a corporate systems context can undermine the systems effort and prove costly in the long run.

- *Communications Between the MIS Function and the Executive Management Team* - For MIS to become an integrated part of the business process, communication between the CIO and other members of the executive team must occur on several levels.

  It is extremely important that an ongoing dialogue exist between the CIO and executive management on the subjects related to long-range planning and goal setting. This is not happening at LSI. Several executives commented that communications with MIS were always focused on problem management. Given the amount of tactical problems resolution required over the last year, this is not surprising. Nevertheless, until commuications beyond the tactical level are established it will be difficult, if not impossible, to establish a long-range systems plan that will be accepted by executive management.

4. Training and Support

Users were generally critical of training and customer support. They felt undertrained and several commented on the poor quality of

documentation, particularly on COLSIS. Others talked about making requests for special reports and feeling that their request had vanished into "the black hole." These issues are not unique to LSI's systems environment. All MIS functions must learn to tune the support function to both the quality of their systems and the sophistication of the end users. INPUT believes that there are several underlying factors that are inhibiting the resolution of the situation at LSI.

- The realignment of management responsibility for the commercial processing network into Integrated Silicon Engineering was probably a good economic move, but has confused users with regard to who is responsible for certain types of customer support. The interviews turned up a number of situations in which MIS's organization was perceived as unresponsive, when in fact the problem was in Integrated Systems Engineering. In particular, the lack of operational support during non-prime shifts and difficulties associated with operating systems conversions were cited by end users.

- LSI's only end-user computing organization is also in Integrated Silicon Engineering. This type of organization is usually the first line of defense when it comes to providing service and support to end-user management.

- The core system, COLSIS, has no help function and is far from user friendly. Individuals working with it on a daily basis undoubtedly require less support as their skills and understanding improve. However, infrequent or casual users will continue to need some level of help from MIS until the user interface can be made more friendly.

Without day-to-day operational responsibility, and lacking a formal organization to deal with end-user support services on a routine basis, LSI's MIS organization is functioning primarily as a systems development and maintenance group. Although INPUT didn't detect any lack of concern for users in the MIS function, some users feel that MIS simply does its thing (implementation) and walks away. Consideration must be given to changing this situation. Longer term, the provision of end-user tools will reduce the need for a constant reliance on MIS for these types of services. But in the meantime, the need for ongoing training and customer support will remain a requirement and needs to be addressed organizationally within MIS.

D

Systems Priorities

A significant part of the user survey dealt with end users' current and future needs. The questions were open ended. Respondents were free to discuss their individual needs, as well as what they believed to be overall corporate requirements for systems initiatives or changes in the systems management processes. Several respondents provided full lists of specific requirements. INPUT assumes that these lists have been reviewed with MIS. These are part of this project's documentation, and can be made available to LSI management upon request.

To analyze the results, INPUT listed all requirements and grouped them into categories with common themes. *Exhibit IV-3* lists the needs by category (theme) in order of their frequency of mention by the eleven business units.

EXHIBIT IV-3

User Priorities for Information Systems

Systems Need	Number Mentions
Worldwide Integration of Operational Systems	6
End-User Information Management Tools	6
Graphical User Interfaces/Integrated Help	6
Improved Long-Range Planning Processes	5
Code and Process Standardization	4
Tighter Integration of Factory Systems	3
Product/Service Margin Reporting	3
Improved Documentation and Training	3
Electronic Data Interchange	2

In addition to the areas listed in *Exhibit IV-3*, individual business units listed several efforts they felt would benefit their specific organizations. Some examples are listed below:

- Laptop automation of the sales force (Sales)
- Currency management systems (Finance)
- Systems to support quality management (Manufacturing)
- Improved office and communications systems/electronic mail

A number of items on the list of user systems priorities warrant further comment.

1. Worldwide Integration of Operational Systems

There seems to be universal agreement by both the manufacturing and marketing arms of LSI that the company should target worldwide integration of its operational systems. There is not universal agreement on how this should be done. A number of interviewees question the strategy of having a single data base.

There are several implications:

- Japan and Canada will need to be integrated into LSI's core systems.
- The corporation (not the MIS function alone) must adopt a set of standard codes, process descriptions and part numbering standards that will permit the integration of the information content as well as the systems.
- The current directions in terms of network and platform strategy must be examined to ensure that it will support a worldwide approach, as well as support longer range requirements.

2. End-User Management Tools/GUI (Graphical User Interface)

A key finding of this study is the requirement to provide the tools and interfaces that will permit end-user manipulation of the growing body of data which exists in COLSIS and other systems. While the implementation of GURU is a step in the right direction, it is not enough. INPUT believes this should be a top priority of the MIS function. Successful implementation of a strategy in this area will:

- Facilitate the use of information that already exists, but is next to impossible for end users to manipulate
- Reduce user requirements for technical support and special report requests
- Provide an opportunity for individual organizations to meet their own unique systems needs within the context of a centrally supported platform and data base environment

3. Long-Range Systems Planning

Clearly there is frustration with the long-range systems planning process. Management is just not comfortable that a real plan exists, or that they and their people are involved. Therefore, it is not surprising that improved long-range systems shows up as a priority item in the survey results. Recommendations regarding how the development of a corporate systems plan might take place are contained in *Chapter VI*.

4. Summary - User Priorities

Respondents were very effective at expressing their views on future requirements and priorities. Some of the systems requirements put forth by the respondents clearly require examination beyond the scope of this study. Automation of the sales force and development of systems that can insure improvements in overall quality are major efforts. Nevertheless, they represent significant opportunities that could provide competitive advantages to LSI.

E

User Attitudes

Although much of the material presented in this chapter could be interpreted as reflecting negatively on the MIS function, INPUT believes that the users' overall view of systems, the MIS function, and the opportunities that systems present to LSI are generally positive. Indicators that this is the case came throughout the discussions with end-user executive management. Some paraphrased quotes offer evidence.

- "I wouldn't want Ed's job. There's no way you can win. Everyone wants to do it their own way, and yet uniformity will be required for LSI to move forward. They're doing OK."
- "MIS has some strong people...and they work hard. It's got to be as frustrating for them as it is for us. We're all learning."
- "A lot has been accomplished in the last year...not without some pain, but I do think we've got to get on with it if we're going to grow."

V. Comparing LSI to Other Firms

This chapter analyzes the interview findings from INPUT's research on information systems in other firms within LSI's industry group. The study examined key issues relative to IS management and corporate culture.

Interviews were conducted with IS executives from eight large corporations utilizing the interview guide in *Appendix B.* Participants included the following firms:

- Advanced Micro Devices
- Applied Materials Corp.
- Hewlett-Packard
- Intel Corp.
- National Semiconductor
- Sun Microsystems
- Tandem Computers
- Raytheon Corporation

A variety of specific topics were explored with each firm, including systems architecture, technology deployment, the use of outside products and services, culture and organization, and systems priorities. A comparison of LSI with the general profiles of these firms concludes the chapter.

A

Systems Architecture

1. Computing Environment - Business and Operational Systems

Of the firms sampled, most use a combination of mainframe, midrange, and PC or workstation platforms, with applications distributed as follows:

. *Mainframe* - High-volume or centralized functions such as financials, order processing, etc.

. *Midrange* - Shop floor manufacturing, regional, or end-user functions

. *PCs/Workstations* - Primarily office automation functions, with most sites moving in the direction of client/server business applications

The interview data gives a general picture of the business systems architectural environment. *Exhibit V-1* summarizes the interview results with regard to platforms and applications. Each characteristic is followed by the number of sites to which it applies. (Since respondents were permitted to respond to more than one answer in each category, the totals may be less than or exceed the total sample of 7.)

EXHIBIT V-1

Survey Results - Platforms and Applications

Architectural Characteristic	Number Mentions
Major Platform	
Mostly Mainframe	2
Mix of Mainframe and Midrange	4
Mostly Midrange	1
PC/Workstations Applications	
Office Systems (PCs/DOS/WINDOWS)	8
Office Systems (UNIX)	3
Client Server/Under Study or Pilot Test	5
Client Server/In Production	1

The primary vendors represented in the sample come as no surprise. The following provides a synopsis of the interview data on key vendors.

- All eight of the companies in the sample utilize IBM or IBM-compatible mainframes for their large-scale business applications.

- Two rely primarily on networked minis to provide distributed business applications in conjunction with their mainframe environments. These were either DEC or HP environments. One firm indicated that it was using AS/400s for this class of application.

- Shop floor business systems were dominated by HP and DEC as well.

In essence, all the interview data supports the conclusion that, in general, LSI's heterogeneous architecture is typical of the firms in the industry.

2. Computing Environment - R&D and Engineering Systems

Although not the primary focus of the study, the survey of competitors did explore the platform environments used for R&D and engineering. Most of the IS executives interviewed were responsible for business and operational systems, and therefore had less knowledge of these systems. Nevertheless, they were able to characterize the platforms and vendors used in their companies' R&D and engineering applications environment. A synopsis of their comments follows.

- Virtually all the companies in the sample relied primarily on high-powered workstations as the primary platform for R&D and engineering. Mainframes are deployed mainly in client/server or heavily compute-bound applications.

- Although most firms utilize a mixture of vendors to provide workstations, the dominant supplier was Sun (six of the eight). Apollo/HP dominated the remaining two; and one firm reported that it was currently working with MIPS as a platform for this class of applications.

B

New Technology Deployment

A part of the survey of competitors was designed to determine to what degree each of their firms was either examining or implementing key information systems technologies. Each interviewee rated each of the technologies listed in *Exhibit V-2* on the degree to which their firm is examining or already deploying the technology. Average ratings are shown on a scale of 1 - 5 with 5 being the highest degree of investment or exploratory interest.

EXHIBIT V-2

Investment/Interest in New Technologies
(Scale of 1 - 5, 5 Highest)

Technology	Average Rating
RDBMS (Relational Data Base Management Systems)	4.1
LAN (Local-Area Network-Based Applications)	4.0
CASE (Computer Automated Systems Engineering)	3.4
Client/Server Architectures	3.0

Some observations that came out of the discussions on new technologies follow:

- CASE is used to some degree at most sites. As is the situation with most of the industry, the degree of success with the use of CASE varies significantly; and most firms have not been able to prove the benefits in terms of real dollar savings. (LSI is not a user of CASE approaches at the moment.)
- Relational data bases are used extensively, although most sites have a large number of older systems that are not relational. Consideration is being given to either re-architecting these systems or rewriting them utilizing relational data base concepts. (Oracle is currently used by LSI in PROMIS, but not as the foundation for COLSIS or other primary business systems.)
- There is a high level of interest in client/server architectures, although most sites are in the research stage with this technology. (To INPUT's knowledge, LSI has no current investigation under way as to how client/server architectures might be deployed in major business or operational systems.)

C
Use of Outside Services

1. Outsourcing

- None of the organizations interviewed are currently outsourcing all or part of their IS function.

- Another firm in the sample recently solicited bids from two large information services firms and found the costs too high.
- One firm recently established an "internal" outsourcing organization to run its data centers.

Clearly, outsourcing is being given consideration to one degree or another by a significant portion of the firms interviewed in this study. The issues relating to outsourcing for LSI are discussed in greater depth in *Chapter VI: Conclusions and Recommendations*.

2. The Utilization of Applications Software Packages

All firms interviewed for this study look to outside applications software packages to provide functionality wherever possible. *Exhibit V-3* lists the classes of major applications software packages ranked by the number of firms in the sample that purchased an outside package to meet their needs.

EXHIBIT V-3

Frequency of Outside Software Purchases

Application Class	Number Mentions
Financial or Human Resources	7
Shop Floor Control	6
Manufacturing Control	5
Distribution	1

A significant outcome of this survey is that in total, six of the eight firms surveyed (all semiconductor forms) use Consilium's shop floor control system. This clearly indicates that LSI should examine its direction in the shop floor control area.

D

Quality Assessment/Systems Priorities

The last two sections of the survey were designed to establish the sample's level of satisfaction with various aspects of the information systems function and to determine key systems priorities.

1. Quality Assessment

Exhibit V-4 presents the average ratings (on a scale of 1 to 5, with 5 being the highest) of respondents' assessments of the quality of various aspects of their systems.

EXHIBIT V-4

Ratings of Competitors' Systems Functions
(Scale of 1 - 5; 5 Highest)

Systems Activity	Rating
Computer Operations/Systems Maintenance	3.9
Engineering Systems	3.8
Communications with IS	3.4
Long-Range Systems Planning	3.3
Business Systems	3.2

Some comparison of these results with those obtained from LSI's end-user interviews follow.

- Competitive firms perceive that their engineering systems are generally of higher quality than their business or operational systems. Even though no specific measurements were done on engineering systems as part of this study, the same general perception exists within LSI based on the comments made during the interviewing process.

- Operational integrity of the business systems processing network was highly rated by participants in the competitive survey. At LSI, end-user survey results rate operations as acceptable, but in need of additional improvement. (Note that operation of the network is currently the responsibility of Integrated Silicon Engineering.)

- Maintenance of existing systems as performed by the MIS function (the applications themselves) was considered acceptable at LSI. Overall, INPUT concludes that LSI is probably operating and

maintaining systems at a comparable level (given its scale of activity) to the firms sampled in the survey.

- Business systems were perceived as acceptable or average in quality by those participating in the competitive survey. End-user interviews at LSI would give business/operational systems a rating of slightly below average.

- The biggest discrepancy between LSI and the sample of competitive firms occurred in two areas: communications with MIS and long-range planning. In both of these areas LSI's end-user executives considered long-range systems planning essentially nonexistent.

To some degree these results are biased in favor of the competitors, due to the fact that the MIS organization represented the primary contact point for the survey. But even taking this bias into account, the differences noted above are probably realistic.

2. Top IS Priorities of Competitors

Respondents were asked to identify their top IS priorities for the next three years as part of the survey. A total of 29 priorities was identified in this process. *Exhibit V-5* groups these twenty-nine systems priorities into five categories ranked by frequency of mention. A brief explanation of each category follows the exhibit.

EXHIBIT V-5

Top Systems Priorities - LSI's Competitors

Systems Priorities	Number Mentions
Downsizing or Distributing Applications	11
Improving User Access to Information	6
Re-Engineering Application/Network Architecture	5
Making Greater Utilization of Outside Resources	4
Moving in the Direction of CASE Technology	3

- *Downsizing or Distributing Applications* was expressed as a systems priority in a variety of ways. In essence, most of the firms are looking at how client/server architectures coupled with open systems standards can be deployed to reduce costs and provide greater flexibility in terms of operational systems.

To date, LSI has not explored downsizing in terms of its business systems. Longer term, the deployment of client/server architectures should be explored by LSI as an alternative to a totally centralized environment.

- *Improving User Access to Information* was collectively the number-two priority of survey respondents, and was consistent with the survey results of LSI user executives. The survey suggests a universal movement to GUI (graphical user interfaces), relational data base management systems, and the provision of end-user tools along with training and support to make end users self-sufficient in terms of their management information needs. This type of effort is not yet under way within LSI.

- *Re-Engineering of Application or Network Architecture* is a common concern of the firms interviewed in the competitive survey. It needs to be more of a priority issue with LSI. LSI must consider how its core applications should be re-engineered. The current underlying data base architectures are not viable over the long haul. Once an applications architecture is established, a reconsideration of the supporting network and platform environment must be undertaken.

- *Making Greater Utilization of Outside Resources* was also a common theme of the survey respondents. Three areas were emphasized.

  - Utilization of off-the-shelf applications software

  - Outsourcing of noncritical professional services under long-term professional services contracts

  - Evaluation of outsourcing options for data processing operations

  All the firms interviewed use outside services and software to some degree. The trend appears to be to more aggressively pursue options available on the outside. LSI should have an ongoing program to consider outside options. As a long-range plan is developed, the areas where the utilization of outside software and services would be most beneficial will become more obvious.

- *Moving in the Direction of CASE Technology* was mentioned explicitly as a priority systems initiative by three of the firms in the sample. To some degree all of the respondents are involved in at least studying CASE at the moment. INPUT believes that this need not be an LSI priority until an overall long-range architectural direction is set, since the nature of the architecture will be a critical factor in selecting the appropriate CASE strategy.

E

Corporate Culture and Organization

The firms interviewed in the competitive survey are in the middle of the spectrum between centralization and decentralization with regard to management of general business operations. Three organizations were very decentralized, two were very centralized. Companies whose primary mission is the design and production of chip technology tended to be in the middle group.

All the firms interviewed had a strong engineering orientation. HP and Sun had more marketing oriented cultures; and all but HP indicated that the style was entrepreneurial.

Participants were asked to rate the degree of centralization of various aspects of their systems function on a scale of 1 - 5, with 1 being highly decentralized and 5 being highly centralized. Average ratings for various aspects of the systems function are shown in *Exhibit V-6*.

EXHIBIT V-6

Degree of Centralization
Competitors' Systems Management Activities

Systems Activity	Rating
Long-Range Architectural Planning (Hardware/Software/Networks)	4.5
Long-Range Applications Planning (Applications)	3.9
Operations (Data Centers/Networks)	3.4
Applications Development	3.1

The results suggest that most firms in the competitive sample have strongly centralized planning for information systems. Likewise, the operations function tends to be more centralized than decentralized. Applications development is handled on a centralized basis for core systems impacting multiple operating divisions, and on a decentralized basis for departmental or divisional systems. Centralized control of the platform environments, standards and operational integrity insures that decentralized development activities will mesh with corporate systems in a consistent way.

This is probably an appropriate model for LSI to adopt. However, until a long-range architectural direction is established for core systems and standards set for decentralized platforms, centralized applications development will be required.

F

Systems Expenditures

As part of the survey process, respondents were asked to estimate their systems budgets for operational and engineering-related systems activities. Of the eight firms in the sample, only three agreed to respond. With such a small sample, it is difficult to draw any statistically verifiable conclusions. Nevertheless, the data does provide some insights with regard to LSI's systems expenditures. *(NOTE: The data used to draw the following conclusions does not include hardware maintenance and data communications.)*

1. Operational Systems Expenditures

- The three responding companies spend approximately 2.8% of annual revenues on operational or business systems.
- The average percent of that budget spent on outside services and software is 18%.

2. R&D/Engineering Expenditures

- Expenditures on engineering and R&D-related systems averaged about 150% of expenditures on operational systems.
- Variation was between 100% and 200%. Raytheon, closest in profile to LSI, ran a ratio of 120%.

3. Conclusions

- The ratio of LSI's expenditures for operational systems, based on revenues of $700 million and systems expenditures of $18 million, are in line with those firms responding to the survey.
- The percentage of the operational systems budget that is being spent on outside services and software is probably below sample results.
- The ratio of expenditures for R&D systems-related activities as compared to business systems is high, but comparable to the ratios of the three companies that responded to the survey.

VI. Conclusions and Recommendations

A number of conclusions and recommendations have been presented throughout this report. This chapter pulls together the results of the study, summarizes the conclusions and presents specific recommendations for action that will assist LSI in obtaining its business objectives through the use of improved systems management.

A

Current Operational Systems

1. Conclusions

- *COLSIS* - Compared to starting from scratch, the migration of COLSIS into the U.S. operating environment was probably the most cost effective. It provides a uniform, corporate-wide way to capture key critical to LSI, and provides functionality to meet LSI's current basic transaction processing requirements. Despite COLSIS' faults it has the redeeming value of forcing a level of standardization that will provide a data base platform from which to evolve, an essential step in LSI's systems evolution.

  However, the system's user interface and data base architecture is unacceptable in terms of meeting the unstructured management information needs of executive and senior staff users.

  Assuming that LSI is looking toward a common approach to manufacturing systems on a worldwide basis, INPUT believes that eventually all operating divisions should migrate to a single set of operational systems. Whether it should be COLSIS long term is an open question. The answer will be determined when a long-range direction can be established for LSI's core systems.

- *Financial Systems* - The utilization of D&B's financial packages is appropriate. The use of this set of packages should be extended to facilitate the consolidation of all of LSI's financial data on a worldwide basis.

- *Core Manufacturing Systems* - Integration of the manufacturing systems (shop floor and others) with COLSIS (or its replacement) is a long-term necessity. The question remains as to what are the appropriate manufacturing systems. INPUT believes that there has not been enough emphasis placed on developing the necessary corporate standards with regard to manufacturing processes, codes, parts identification, etc. This is needed to determine whether the systems currently in place can effectively handle an expanding worldwide manufacturing operation.

  The manufacturing systems environment is confronted with both short- and long-term issues.

  - *Short Term* - Due to the fact that the vendor will shortly terminate support for the currently installed version of PROMIS, there is significant pressure to move forward with a major upgrade.

  - *Long Term* - It's not clear from INPUT's study that an overall direction with regard to the use of common manufacturing systems at all locations is fully supported by the manufacturing organization.

  The question is how to proceed under this set of circumstances.

- *Management Information Systems* - Although COLSIS has the systems integrity and capability to deal with the data entry and management aspects of LSI's core business and transaction processing requirements, it lacks the functionality and ease of use required to make that data available as management information.

  GURU helps facilitate the manipulation of the data base, but is inadequate to deal with ad hoc on-line query. Recommendations for this class of systems are contained in this chapter, *Section E.*

Even with all the issues raised here about the individual applications, a significant amount of progress has been made in the last year which is directionally correct.

  - The level of integration of operational systems has improved by an order of magnitude, an absolute long-term necessity.

  - The level of data quality has improved significantly.

  - Initial steps have been made in the standardization of codes, etc.

2. Recommendations

- *COLSIS* - The European implementation of COLSIS transaction processing should continue as planned. As implementation proceeds, an examination of COLSIS' long-term viability should be undertaken. Chances are COLSIS can met LSI's needs longer term, but will require some re-architecting. The answer to long-term viability of COLSIS should be obtained as quickly as possible to determine whether COLSIS implementation should proceed for Canada and Japan as well.

- *PROMIS* - The major study and pilot under way on this system should continue. However, it is INPUT's opinion that a committee of 30 cannot be effective in making a final decision.

  - Manufacturing executive management needs to take a leadership role in bringing the decision process to closure.

  - The outside survey conducted as part of this study indicated that a large number of other firms are using Consilium to provide part of the PROMIS/MAESTRO capability. Presumably this option has already been considered by LSI. If not, the current PROMIS evaluation should examine Consilium as a serious long-term alternative before committing to the significant expense that is likely to be involved in upgrading PROMIS.

- *LPROJ/CPROJ* - As LSI's need to manage professional services accounting and revenues grows, the viability of these two systems will need to be tested. Over time, they should become one.

- *Financial Systems* - The selected suite of financial systems should sustain any future LSI requirements. INPUT recommends no change.

B

Architecture

1. Conclusions

- The current systems are implemented in an aging architecture and no architectural plan for networks and platform environments currently exists. While IMS and hierarchical networks will be here for many years to come to support structured transaction processing applications like COLSIS, consideration needs to be given to how that architectural strategy (IMS) inhibits the growing need to provide management information and decision support systems The

IBM/IMS (or VAX equivalent) environments do not provide the necessary tools or user friendliness to permit end users to accommodate their own management information needs.

- The sampling of competitive firms indicates that the direction is toward more distributed processing and end-user-managed applications than is currently planned for LSI.

2. Recommendations

A study needs to be conducted to examine alternative architectures and platforms that would support relational environments and the possibility of distributed local data bases.

C

Outsourcing

1. Conclusions

There is little doubt that there is an opportunity to approach outsourcing for certain functions, but not until a long-range architectural direction is set.

- Going into a large-scale outsourcing agreement with LSI's existing plan could place LSI at a disadvantage in terms of having to negotiate, after the fact, fundamental changes it might require in the operational applications suite or platform architecture once a long-range plan is put in place.
- With no plan agreed to and in place, the outsourcing firm's plan could become LSI's plan.

INPUT believes that there clearly is an opportunity for outsourcing at LSI. However, it will require additional work on LSI's systems directions and outsourcing requirements before a successful and mutually beneficial agreement could be struck with a potential outsourcing partner.

2. Recommendations

To position itself to evaluate outsourcing alternatives, LSI needs to take a number of steps. The following needs to be accomplished:

- Key decisions about long-range plans for core applications must be made so they can be incorporated into negotiations strategy with potential outsourcing partners.
- Good forecasts regarding future transaction volumes, new lines of business and potential key geographic expansions need to be developed.
- A negotiating strategy must be developed that will put LSI in a control position.

The planning information necessary to help structure an outsourcing decision could be obtained through a focused study with the assistance of outside consulting support, or the internal development of a long-range plan. INPUT recommends placing high priority on the development of a long-range plan, then the utilization of outside consultants to assist in developing the negotiating strategy.

D

Systems Expenditures

1. Conclusions

As pointed out in the last chapter, LSI's expenditures are currently in line with other firms INPUT was able to test in the survey. If anything, expenditures for operational systems are probably a little on the low side.

2. Recommendations

Additional expenditures should be made to establish an end-user and customer support function within MIS. Project funding should be provided to jump-start the planning processes necessary to bring resolution to many of the issues raised in this report.

E

Customer Service and End-User Support

1. Conclusions

- From an end-user (internal customer) viewpoint, MIS lacks a service and support orientation. This problem is amplified by both organizational and cultural issues identified in the study.
  - MIS is currently organized to provide implementation services, not ongoing customer support.
  - The separation of responsibility for day-to-day computer operations from the MIS function confuses users with regard to which organization to go to for support.
- The fact that there is no end-user computing function within MIS presents a significant problem. End users increasingly want to be able to utilize the storehouse of data being managed by systems such as COLSIS for their own business analysis. Without an organization technically equipped and chartered to facilitate that process, a lot of energy and money will be spent by end users on misdirected efforts to meet that need.
  - A proliferation of ad hoc systems of questionable integrity will evolve that will require significant resources to maintain over the long run.
  - Accommodating the interface requirements to this growing array of systems will make it increasingly difficult to modify and upgrade the core systems themselves.

A number of recommendations are made later in the chapter which INPUT believes can resolve these issues.

2. Recommendations

a. End-User Computing

The creation of an end-user computing function should be top priority for MIS. This organization should be chartered to:

- Select a suite of tools based on a GUI (graphical user interface) and tailored to allow access to LSI's existing data base structure. The tool set should include personal use software for word processing

and spreadsheet support. Consideration of tools that will operate similarly in both the Apple and IBM environments is critical, since both are present at LSI.

As part of this process, the use of PROFS as LSI's primary electronic messaging environment needs to be considered.

- Provide training and support to end-user executives and others in user departments having a need for these capabilities.
- Identify existing user-developed applications that should be documented, refined and made available to other end users throughout LSI.
- Develop applications that will operate on the end-user tool set to meet information requirements common to multiple executives within LSI (Executive Information Systems).
- Provide one-call help desk support throughout the organization.
- Assume responsibility for PROFS and provision of support to LAN environments installed outside of the R&D and engineering functions.
- Manage a data base of information extracted from several of LSI's on-line operational data bases to function as a platform for management information and Executive Support systems.

INPUT believes these activities could be started almost immediately, even though it might take some time to finalize a longer range architectural plan.

b. Customer Support - Transaction Processing

Users of LSI's operational systems on a day-to-day basis (for transaction processing rather than analysis purposes) also require support. At present there is no single focus for this activity. With Integrated Silicon Engineering actually operating the systems, and MIS providing support on the applications themselves, users tend to be confused on where to get certain kinds of help.

The process for providing this type of support needs to be re-examined and strengthened. Whatever changes are made should take into account that LSI's systems are becoming global in nature. As a consequence, whatever processes are put in place need to be supported on a three-shift, seven-day-a-week basis.

Finally, as in the case of management users, consideration needs to be given to simplifying the interface between transaction processing users and the core systems.

F

Systems Management Processes

1. Conclusions

Chapters IV & V discuss LSI and competitors' systems management processes in considerable detail. The following points highlight the key conclusions from both the in-house and external company surveys.

- LSI is severely lacking in a long-range systems planning process to address end-user needs and priorities. Although a plan does exist for integration of the existing systems, it does not address such items as:
  - The development of company operating philosophies upon which systems strategies can be developed
  - The integration of newer technologies which could reduce costs or facilitate a greater degree of end-user involvement in meeting their own information needs
  - Longer term migration strategies for network and data base environments that would provide greater architectural flexibility
  - Standardization on key technologies to bridge the next five years
- Project management of specific implementation activities appears to be fairly strong. Volume testing and other areas probably need some improvement, but in general the systems portion of the implementation process works.
- Project leadership--in terms of pulling together all the non-systems-related efforts required to support a successful corporate-wide implementation--needs significant improvement.

2. Recommendations

a. Long-Range Systems Planning

A long-range systems planning process should be initiated as soon as possible. The process does not need to be overly formal, but it should address the following issues:

- Clarification of long-range business objectives regarding globalization of manufacturing and accounting processes for the core custom chip business

- Longer term needs and the degree of systems standardization required to handle emerging aspects of LSI's business such as high-volume chip sets, or the requirements of subsidiaries such as Headland Technology.

- Major systems architectural issues such as downsizing and/or distributed data base strategies. For example, an analysis should be done to determine

  - Whether migration of systems such as COLSIS to a relational or distributed relational data base environment will improve functionality and price/performance

  - Whether a common data base architecture for all manufacturing-related systems is the right long-range direction to support the business requirements

  - Whether a separate data base for management information and executive support systems is required

b. Systems Installation and Test

The installation and test activity should be reviewed and modified to deal with the issues raised in *Chapter IV*. Aspects of this process that should be given particular scrutiny are user training, on-site user installation support, volume testing, and help desk activities.

c. Project Management

Many of the problems arising during the implementation of COLSIS could have been avoided if operational management had been more directly involved in the project planning and implementation process. MIS appears to do an acceptable job in terms of getting the code installed. However, a process that engages more active leadership on

the part of user management is necessary for those project activities not directly under MIS's control.

A process to insure that end-user management is directly involved not only at project approval and initiation, but also at implementation, needs to be adopted.

G

Executive Leadership (Corporate/MIS)

1. Conclusions

LSI's Office of the Chief Executive has clearly made a commitment to centralized leadership and professional management of MIS-related activities through the creation of the CIO position. Authority was given to MIS to move forward aggressively.

The internal interviewing process identified some potential reasons why implementation of this mandate hasn't been as successful as desired:

- Lack of clarity on long-range corporate direction. (In other words, a sound systems plan needs to be built on a sound, and agreed to, statement of long-range business direction.)

- Lack of continued reinforcement of MIS's mission with the rest of the management committee

- Lack of leadership by operational executives on matters such as standardization of coding and manufacturing processes which are critical to the implementation of truly global systems

- The MIS organization believed it was chartered to "charge" forward and assumed other organizations would respond supportively. However, many executive-level managers and users feel uncomfortable about how systems implementation and changes will impact their organization. They may also lack experience in fulfilling their role in the implementation of large corporate-wide systems.

- MIS hasn't really established a process for managing non-systems efforts necessary to successfully implement systems changes.

To rectify these issues, changes in the management process need to occur that will:

- Insure that the systems planning process identifies and accommodates non-systems-related efforts that are critical to successful implementation
- Cause end-user executive management to assume responsibility for implementation of their part of the plan, and manage in support of the mandate established for MIS

2. Recommendations

- An executive Systems Steering Committee should be established to focus on the high-level strategy issues, as opposed to implementation or problem resolution.
- Outside support in the form of consulting services could be used to address such items as planning processes and the education of user executive management on its role in systems management processes.
- MIS needs to take an active role in the business planning process.

H

Computer Operations

1. Conclusions

- Operations is currently managed by Integrated Silicon Engineering (ISE). Apparently some levels of end-user support are provided by that organization as part of its mission. To some degree, users are confused about who provides which classes of support--MIS or ISE--and to whom they should go to make requests for service.
- European users expressed some concern in the survey about the level of support and service provided by operations during non-prime time (Pacific Standard Time). Bringing COLSIS on-line from Europe into the California data center will aggravate this problem.

2. Recommendations

- While there is no reason that computer and network operations must be managed by MIS for the operation to be successful and effective, INPUT recommends that a single user interface should exist under the management of MIS.

- If not already completed, a study should be done by operations to establish the precise support requirements necessary to move to what is essentially a twenty-four-hour-per-day, seven-day-per-week operational environment.

I

Summary - Conclusions and Recommendations

LSI is at a crossroads in the evolution of its information systems. The work that has been done in the last year has been significant, and lays a foundation for moving forward. Nevertheless, some key decisions need to be made now which will impact the effectiveness of the systems environment significantly over the next five years.

To some extent making the correct decisions from here on out is as heavily impacted by LSI's long-range business objectives and style as by the continued push of technological alternatives.

A summary of the key action steps discussed earlier point to:

- Taking short-term action to address executive information requirements

- Developing a total MIS long-range plan that is more than a short-term application development strategy. The plan, in supporting the overall business direction, should:

  - Address the long-term direction for transaction processing and the COLSIS system

  - Consider further integration of manufacturing systems

  - Provide for the necessary architecture and professional services to fully support Executive Information Systems

  - Define LSI's requirements with respect to outsourcing

- Reorganizing customer support so that there is a single spot where customers begin their search for help, and implementing processes to get results from the organization(s) ultimately responsible.

- Establishing agreement with corporate management to recognize and accept their mutual responsibility to see that LSI's systems are designed and operated to achieve the corporation's objectives.

Finally, INPUT believes that LSI should adopt a model for managing systems that has the following characteristics.

- Relies on strong centralized planning processes and coordination of standards.

- Centralizes management of operations and data administration even though the ultimate form of LSI's operational network and database environment might well be quite distributed.

- Decentralizes (over time) of applications development activities unique to individual operating divisions.

- Establishes operating executive (user) involvement in major systems related projects such as setting manufacturing standards.

- Facilitates approach to end-user customer support and executive information systems.

INPUT believes this type of approach will encourage user ownership and participation in the systems management process in a manner consistent with LSI's corporate culture. The result will be systems that efficiently sustain day-to-day operations, and also support the growth and evolution of LSI's business.

Appendix A: MIS/User Interview Roster

The following table *(Exhibit A-1)* identifies by business unit (organization) and name individuals from MIS and user business units who were interviewed as part of the study.

EXHIBIT A-1

Individuals Interviewed by Organization

Organization	Name	Title
LSI Logic Corporation Information Systems	Ed Cannon Steve Chazan Bill Miller Paul Garber David Doeltz	Vice President/CIO Dir. Manufacturing Systems DBA COLSIS Support COLSIS Analyst Programmer Analyst
Headland Technology	John Dickson	President/CEO
LSI Logic Europe	John Dyson	Vice President - Finance
LSI Logic Corporation Microprocessor/DPS	Brian Halla Charles Alvarez	Senior Vice President Dir., Finance & Ops.
LSI Logic Corporation Finance	Pat Jones Kathie Ittel JoAnn Scarbrough	Vice President/CFO Credit Manager Dir., General Accounting
LSI Logic Corporation Sales	Bob Skinner Bruce Parson Frank Tornaghi	 Sales Administration Mgr. Area Sales Manager
LSI Logic Corporation Customer Svcs. & Logistics	Chuck Smith Al Tippetts	Vice President Production Control & MM

LSI Logic Corporation Office of the Chief Exec.	George Wells Wilf Corrigan	President & COO Chairman & CEO
LSI Logic Corporation Worldwide Operations	Cy Hannon	Executive Vice President
LSI Logic Corporation Integrated Silicon Engr.	Jim Koford	SVP - Chief Tech. Officer
LSI Logic Corporation ASIC Products Group	Bob Blair David Schirle Kevin Bligh	Senior Vice President Controller Dir., Tactical Marketing

Appendix B: Interview Guides and Questionnaires

This appendix includes the following questionnaires:

- *INTERVIEW GUIDE: LSI Operational Systems Assessment*
  Data collection vehicle for end-user and MIS management interviews.
- *INTERVIEW GUIDE: Attachment A*
  Data collection vehicle for user assessments of the effectiveness of various operational systems.
- *SYSTEM PROFILE: LSI Operational Systems Assessment*
  Data collection vehicle on LSI's key operational systems.

INTERVIEW GUIDE
LSI - OPERATIONAL SYSTEMS ASSESSMENT

The following interview guide has been designed to gather specific information from user executives of major operational systems managed by the Management Information Systems organization at LSI. The guide will be used by INPUT's project management to gather information on systems needs, the status of present systems, and the systems planning process. Individual responses will be considered confidential.

POSITION/ORGANIZATION

Name: ____________________________

Title: ____________________________

Reports To: ________________________

Reporting Structure: *(Please list all reporting functions and the manager's name.)*

______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________

Function: *(Please give a brief description of the role of your organization within LSI.)*

____

____

____

____

____

____

KEY SYSTEMS

Could you please list those systems that are critical to the accomplishment of your organizations mission. Once the list is completed we'll talk about each system individually in terms of its quality support, and future plans.

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________

(One INTERVIEW GUIDE - ATTACHMENT A should be completed for each of the critical systems listed above.)

SYSTEMS MANAGEMENT PROCESSES

For each of the following systems processes, please give your assessment of the quality with which the process is managed utilizing a rating scale of 1 - 5. *(1 being poor quality, and 5 being high quality)* Also provide any comments that you might have regarding the reasons for the rating.

Process	R*	Comments
Systems Planning - Long Range		
Systems Planning - Short Range		
Systems Design		
Systems Maintenance		
Systems Installation & Test		
User Training		
Post-Installation Assessment		
Quality Assurance		
General Communications		
User Involvement in Design/Inst.		

* - Indicate 1 to 5 rating in this column.

GENERAL COMMENTS

In your view what needs to be done with regard to systems related management processes to improve the overall effectiveness of your organization's systems?

If there were no resource constraints, what would be your top five priorities for systems within your organization?

(1)__________

(2)__________

(3)__________

(4)__________

(5)__________

Do you have any other comments regarding the systems activity as it relates to your organization or LSI Logic in general?

Who in your organization provides an active interface with MIS? And, what does that person do?

SYSTEM PROFILE
LSI - OPERATIONAL SYSTEMS ASSESSMENT

The following profile has been designed to gather specific information on the major operational systems managed by the Management Information Systems organization at LSI. One profile should be completed for each major system.

SYSTEM DESCRIPTION

System Name: ________________

Primary User: ________________

Secondary Users: ________________

____

____

Age of System: ________________

Source:
- [ ] Purchased
- [ ] Purchased/Modified
- [ ] In-House Developed

Platform: ________________

DBMS Utilized: ________________

Function: *(Please give a brief description of the functional capabilities of the system.)*

____

____

____

____

No. of Online Users: ________________

Volume Parameters: ________________ *(Transactions per day, etc.)*

RELATED SYSTEMS

Provide Data For: ________________ ________________

________________ ________________

Receive Data From: ________________ ________________

________________ ________________

Comments ________________________________

MIS RESPONSIBILITY

Development Mgr.: ____________ Committed EFT: ____________
(Equivalent Full Time)

Maintenance Mgr.: ____________ Committed EFT: ____________

Accomplishments This Year (1991):

____

____

FUTURE PLANS

Please describe the plans for this systems for 1992 *(Include EFT Commitments)*:

____

____

____

Please give your views on the long range strategy with regard to this system:

____

____

____

QUALITY ASSESSMENT

For each of the following categories please provide a rating of (1 - 5), with five being the highest, of MIS's assessment of overall quality.

_____ User involvement in development of plans for the system.

_____ User perceptions of MIS responsiveness in resolving operating problems.

_____ The quality of long range plans for this system.

_____ MIS's perception of how well the system meets user needs.

_____ MIS's perception of the overall quality of the system.

INTERVIEW GUIDE
INFORMATION SYSTEMS IN HIGH TECH FIRMS

This interview guide has been prepared for use in INPUT's analysis of IS trends in high technology firms. The purpose of the study is to examine the relationship between IS organization/priorities and corporate culture.

ARCHITECTURE

1.0 For your business and operational systems -- finance, administration, manufacturing, order entry, etc -- will you generally describe your computing environment?

(Prompt -- MAJOR PLATFORMS: mainframe, mini, PCs/workstations, LANs; PRIMARY VENDORS: single vendor or mixed)

____

____

____

____

____

1.1 For your R&D and Engineering systems will you generally describe your computing environment?

(Prompt -- MAJOR PLATFORMS: mainframe, mini, PCs/workstations, LANs; PRIMARY VENDORS: single vendor or mixed)

____

____

____

____

____

For each of the following, please indicate the degree (on a scale of 1 - 5 with five being the highest) to which your firm is either investigating or implementing the following IS technologies.

1.2 _____ CASE (Computer Automated Systems Engineering).

1.3 _____ RDBMS (Relational Database Management Systems).

1.4 _____ LAN (Local Area Network Based Applications).

1.5 _____ Client Server Architectures.

Comments:

OUTSIDE PRODUCTS AND SERVICES

2.0 Are you currently outsourcing all or part of your IS function or considering the possibility of doing so?

If YES, will you please describe your reasoning, and the portion of the IS function that you would consider for outsourcing?

2.1 Please list and describe those major applications systems that you have purchased outside. (Manufacturing, financial, etc.)

(a)____

(b)____

(c)____

(d)____

(e)____

(f)____

QUALITY ASSESSMENT/PRIORITIES

On a scale of 1 - 5 (with five being the highest), please give me your impression as to the degree of satisfaction that your firm has with each of the following aspects of the IS function.

3.0 _____ Overall quality and integrity of the business systems environment.

3.1 _____ Overall quality and integrity of the R&D/Engineering systems environment.

3.2 _____ Overall quality of long range plans for systems activities.

3.3 _____ Overall integrity of the operating environment.

3.4 _____ Overall quality of communications with IS.

I'd also like to get an idea of what your top IS priorities are, i.e., what do you consider to be the most critical things that need to happen in your systems environment over the next three years?

(a)____

(b)____

(c)____

(d)____

CORPORATE CULTURE/IS ORGANIZATION

I would like to get a feeling for your organization and company culture. For each of the following statements, please indicate on a scale of 1 - 5 (with 5 being the highest) your view on the degree to which the statement describes your firm.

4.0 _____ Highly centralized control (5) vs. highly decentralized (1).

4.1 _____ Engineering/product oriented (5) vs. marketing sales oriented (1).

4.2 _____ Entrepreneurial (5) vs. structured (1)

Additional comments on corporate culture:

____

____

____

____

____

____

Now, I'd like to get an idea of your IS organization, focusing on the degree of centralization. For each of the following systems management activities, please indicate your impression of how centralized the management of the function is within your firm. Use a scale of 1 - 5 with 1 being highly decentralized and 5 being highly centralized.

4.3 _____ Long range systems planning for applications.

4.4 _____ Long range systems planning for hardware/software/networks.

4.5 _____ The development of new applications systems.

4.6 _____ The operation of data centers and networks.

DEMOGRAPHICS

Please provide whatever estimates you can in response to the following questions. As with all information collected in interviews, these figures will be kept *STRICTLY CONFIDENTIAL*.

Revenues/Headcount:

5.0 __________ Could you please give an estimate of your firm's annual revenues world-wide? (Millions)

5.1 __________ Approximately how many employees do you have domestically? (Thousands)

5.2 __________ Approximately how many employees do you have internationally? (Thousands)

IS Budget/Headcount:

6.0 __________ What is your estimate for your firm's total annual IS budget? (Millions) If you are unable to estimate in ($), could you possibly give me an estimate in terms of % of revenue?

6.1 __________ What is your estimate for your firm's total number of full-time IS employees?

6.2 __________ Approximately what dollar amount or percent of your annual IS budget is spent with outside vendors? (Not including hardware maintenance and data communications services.)

Engineering Systems Budget/Headcount:

Do the above estimates include IS expenses associated with R&D and Engineering?

If YES,

6.3 __________ % IS budget for R&D/Engineering.

6.4 __________ % IS employees dedicated to R&D/Engineering.

IF NO,

6.5 __________ Could you give me an estimate for total IS-related R&D/Engineering expenses?

Thank you for your assistance! We will send you a summary of our findings upon completion of this study (approx. 5 page summary, March '92).